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**Establishment Record for
Browse Research Natural Area
within Dixie National Forest**

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AGREEMENT

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NATURE
CONSERVANCY

ESTABLISHMENT RECORD FOR
BROWSE RESEARCH NATURAL AREA
WITHIN DIXIE NATIONAL FOREST
WASHINGTON COUNTY, UTAH

INTRODUCTION

Spread across much of southwestern and south-central Utah, the various Districts of the Dixie National Forest support a diverse assemblage of forest and rangeland habitats. The Pine Valley Mountains in particular contain features that are unusual for National Forest lands in Utah. All of these areas have been used pervasively for production of resources to support and benefit adjacent human settlements. Activities such as timber harvest, domestic livestock grazing, mineral extraction and dispersed recreation have proceeded from the presence of explorers and settlers beginning in the middle of the 19th century (Alexander 1987).

Complementing the multiple use of resources in this part of Utah is a need to maintain undisturbed examples of the area's natural diversity. This is especially important in areas such as southwestern Utah where human populations, and their pressures on natural resources, are increasing dramatically. A means of conserving undisturbed areas on National Forest lands is through administrative designation of Research Natural Areas (RNAs). These serve to register and protect certain ecosystems as benchmark or reference areas.

The eastern side of the Pine Valley Mountains contains a disjunct belt of evergreen chaparral vegetation that has affinities with more extensive chaparral communities to the south and west. A good example of this vegetation type in Leeds Canyon was suggested for inclusion in the system of RNAs at an initial RNA needs workshop for Utah and Nevada (Van Pelt 1982). The area was visited in June 1984, and a follow-up "reconnaissance" report was prepared (Tuhy 1985) that proposed RNA designation for a tract of about 1100 acres (445 ha) on the northeast side of Leeds Creek. For various reasons this area was not carried forward as a candidate RNA into the Dixie National Forest Land and Resource Management Plan (USDA Forest Service 1986b). In the meantime, much of this prospective RNA was burned over in a 1986 fire, and subsequently reseeded with a mix of largely non-native species.

A Region-wide initiative was undertaken in the mid 1990's to achieve RNA designation for a handful of sites that had been previously identified as qualified, but for which formal action had not been taken. Leeds Canyon was included in this process, and was visited by the author of this Establishment Record along with District and Forest staff people and faculty members from Brigham Young University in June 1997. This group quickly rejected the possibility of locating an RNA in the Leeds Canyon drainage, owing to altered conditions (i.e. the exotic species seeded after the 1986 fire) and the difficulty of managing an RNA in this area of high (and ever-increasing) human recreational pressures.

The group did, however, investigate an alternative area farther north of Leeds Canyon, along the road into the Browse Guard Station. A particular tract was located that was substantially recovered from past disturbances and that contained appreciable amounts of evergreen chaparral vegetation -- though not as extensive or well-developed as in Leeds Canyon. This new tract did, however, have a greater diversity of other vegetation types and close proximity to an administrative facility (the Guard Station) that could serve as a base for researchers. The opportunity now exists to recognize and protect the values of this tract identified in 1997 by designating it as the Browse Research Natural Area (BRNA).

The BRNA consists entirely of reserved lands of the Dixie National Forest. About 6% of the area lies within the Pine Valley Mountain Wilderness. None of the area is within nor does it contain any other Congressionally-designated areas such as National Recreation Area or Wild and Scenic River.

Land Management Planning

The Regional Guide for the Intermountain Region (USDA Forest Service 1984) includes policy, general guidance, and Regional planning requirements for RNAs. The more recent Regional Desk Guide (USDA Forest Service 1993) reiterates that selection and establishment of RNAs shall be a part of the continuing land and resource management planning process. Relevant portions of these Regional documents are included in Appendix A.

The Dixie National Forest Land and Resource Management Plan ("Forest Plan"; USDA Forest Service 1986b) and Environmental Impact Statement (USDA Forest Service 1986a) contain more-specific policy and guidance for the establishment and management of RNAs on the Forest. Selected materials pertaining to RNAs from these two documents are included in Appendix B.

The Browse site is not identified as a candidate RNA in the current Forest Plan. At present, the Forest Plan identifies the Browse site as being within portions of three Management Areas: 4C (Wildlife Habitat - Brushy Range), 8A (Wilderness) and 9B (Intensive Riparian Management), of which the first is by far the largest. Emphasis in Management Area 4C is on wildlife habitat in hardwood and shrub-dominated draws and other areas of woody vegetation to sustain their inherent biological, physical, and visual values. Emphasis in Management Area 8A is to provide for the protection and perpetuation of essentially natural bio-physical conditions. Emphasis in Management Area 9B is to enhance riparian vegetation, improve water quality, improve wildlife and fish habitat, increase wildlife populations, and improve stream channel stability. As explained later in this Record, conflicts between these land uses and the values that make the Browse site qualified for RNA status appear to be minimal.

The analysis and recommendations necessary for designating the Browse site as an RNA are contained within an Environmental Assessment (USDA Forest Service 1998b; Appendix C) and Dixie National Forest Plan Amendment (USDA Forest Service 1998a; Appendix D). The result of these analyses and the subsequent decision is to change the status of the Browse site to Management Area 10A, a Research Natural Area.

OBJECTIVES

The chief objective of the Browse RNA is to preserve and maintain in undisturbed, naturally-functioning condition the biological and genetic diversity present within exemplary vegetation types and habitat occurrences within the area. These include examples of terrestrial forest, woodland and shrubland types; riparian woodlands; and distinctive landform, soil and geologic types.

Establishment and protection of the BRNA will further the long-term objective of setting aside at least one example of all the habitat or vegetation community types represented on National Forest lands in Utah or Region 4 (Federal Committee on Ecological Reserves [FCER] 1977). As explained in the following section, the BRNA contains five vegetation types that would be new to the RNA system within the Southeastern Great Basin geographic Section.

The BRNA will also provide a reasonably accessible reference site for basic, non-manipulative studies of biotic patterns, ecological processes, natural disturbance regimes, and community succession. Left undisturbed by human intrusions, it will afford managers and conservation scientists a benchmark for assessing long-term ecological and geomorphological changes, plus inherent productivity (Passey et al. 1982). Such a benchmark would be especially useful for comparing the effects of resource management techniques and practices on multiple-use lands nearby (Johnson 1989).

JUSTIFICATION STATEMENT FOR ESTABLISHMENT OF AREA

An initial estimate of RNA needs in Utah and Nevada identified examples of chaparral at mid-elevations in Great Basin Mountain Ranges as a key RNA need (Van Pelt 1982, Table 27). Further, oak scrub and montane chaparral cells were identified as having potential for RNA representation in the Pine Valley Mountains (Van Pelt 1982; Table 21).

A recent analysis of RNA needs on National Forest lands in Utah (Tuhy 1998) focused on vegetation types as the cells to be targeted for inclusion in the RNA system, segregated according to geographic divisions of the state known as Sections (McNab and Avers 1994). This analysis found that designation of the BRNA would fill five new cells within the Southeastern Great Basin Section. Table 1 shows the specific cells that are represented in the BRNA, and the level of their representation.

Pertinent excerpts from the initial RNA needs estimate (Van Pelt 1982) and from the recent analysis (Tuhy 1998) are included in Appendix E, as documentation of the needed natural diversity elements.

Table 1. Specific cells represented in the Browse RNA, all of which fill unmet RNA cell needs in the Southeastern Great Basin Section, and the level of their representation.

CELLS - VEGETATION TYPES	REPRESENTATION	
	MAJOR	MINOR
TALL FOREST COMMUNITIES		
<i>Pinus ponderosa/Arctostaphylos pungens</i> (ponderosa pine/Mexican manzanita)		X
SHORT FOREST, WOODLAND AND SHRUBLAND COMMUNITIES		
<i>Fraxinus velutina</i> (velvet ash)		X
<i>Pinus monophylla-Juniperus osteosperma</i> (single-needle piñon pine-Utah juniper)		X
<i>Quercus gambelii-Cercocarpus montanus-Amelanchier utahensis</i> (Gambel oak-birchleaf mountain mahogany-Utah serviceberry)		X
<i>Quercus turbinella-Garrya flavescens</i> (Dixie live oak-silk-tassel bush)		X

Designation of the BRNA would also add a number of landform and geologic cells to the RNA system, according to the classifications in FCER (1977; pp. 14-19). Because these cell categories are not well-defined within the FCER document, however, a listing of such specific abiotic cells present in the BRNA is not given here.

Another justification for establishment of the BRNA involves the use of the area for research. Though no studies are known to be taking place within the area at the present time, the BRNA could support extensions of existing, localized research focusing on specific communities and their ecotones. Examples of such research include Austin (1987); Brotherson et al. (1984); Carmichael et al. (1978), Conrad and Oechel (1981); and Wells (1960).

PRINCIPAL DISTINGUISHING FEATURES

The BRNA encompasses portions of several valleys and intervening ridge crests within the foothills on the east side of the Pine Valley Mountains (Photos 1-4). These landforms are derived from largely westward-dipping sedimentary strata (sandstones, conglomerates, shales and limestones) that are covered in places by veneers of intrusive igneous rocks washed down from the core of the Pine Valley Mountains above to the west (Cook 1957; Cook 1960).

The BRNA contains an assemblage of plant communities that are representative of its range of elevations and substrate types on the east side of the Pine Valley Mountains. Among the various terrestrial communities present, shrublands of Gambel oak, birchleaf mountain mahogany and Utah serviceberry are quite extensive, especially at the higher elevations of the area. Open forests of ponderosa pine and woodlands of single-needle piñon pine and Utah juniper appear to be largely associated with certain sedimentary strata. Evergreen chaparral shrublands appear to be best-developed on igneous gravel substrates, but also occur on some sedimentary parent materials in lower portions of the area. Finally, several of the drainages contain perennial streams, along which riparian woodlands and shrublands occur.

These various features are present in little-altered or substantially-recovered condition. Apart from the road through the area and several trails within it, the BRNA contains no substantial evidence of human works or major effects of past livestock grazing or woodcutting.

LOCATION

The Browse RNA is located on the Pine Valley Ranger District of the Dixie National Forest. It lies about 4 miles (6 km) northwest of Pintura and 23 miles (37 km) northeast of St. George, in north-central Washington County (Maps 1-3). Latitude and longitude for the approximate center of the area are 37°22' North and 113°20' West, respectively. The least rectangle that includes the whole area is defined (to 30-seconds precision) by the following latitude/longitude lines: North - 37°23'30"N; South - 37°21'00"N; West - 113°22'00"W; East - 113°19'00"W. Specifically, the area lies in portions of sections 19, 20, 21, 28, 29, 30, 31, 32 and 33 of T39S R13W, Salt Lake Meridian (Maps 3-4). It is shown on the New Harmony and Pintura 7.5' topographic quadrangles. Stereo coverage is provided by eight aerial photographs, housed at the Pine Valley Ranger District Office:

6-27-90	USDA-F	16 614070	190-25 through 190-28
7-16-91	USDA-F	16 614070	690-43 through 690-46

The exterior boundary of the BRNA (Map 4) corresponds with generally well-defined ridge crests and drainage courses for most of its length. This boundary follows an old, reclaimed road along part of the southern edge of the area. The corridor containing Forest Road #037 is excluded from the BRNA, effectively separating the RNA into two segments. This corridor extends out 15 feet (5 m) from the edges of the road, or from the edges of vehicle pullouts or any previously-disturbed areas that currently exist along the road, including a 30-foot (10-m) extension around the gravel-pit disturbed area near the crossing of Harmon and Mill Creeks. A description of the BRNA boundary is provided in Appendix F. The

BRNA (excluding the road corridor) encompasses an area of 2180 acres (880 ha). Elevation ranges from about 4930 feet (1505 m) where South Ash Creek crosses the southeastern boundary of the area, up to about 7000 feet (2135 m) on the ridge crest at the extreme northwestern tip of the area. This represents a vertical relief of about 2070 feet (630 m).

Access into the BRNA is via the Browse exit (#30) from I-15, about 22 miles (35 km) north of St. George and 29 miles (46 km) south of Cedar City. Proceed west from the Interstate on the gravel road slightly over 1 mile (1.6 km) to the Dixie National Forest boundary. From this point continue on the main gravel/dirt road, Forest Road #037, about another 2.3 miles (3.7 km) to the southeastern corner of the BRNA, where the road goes onto a very narrow (and scenic) section of ridge crest; the road can be followed for about another 4½ miles (7 km) through the BRNA to the Browse Guard Station. This main access road is generally suitable for high-clearance two-wheel-drive vehicles (not passenger cars), although four-wheel-drive capability may be desirable to get through some very sandy stretches southeast of the BRNA. This access road is closed to all motor vehicles except snowmobiles and ATVs at about the point where it enters the BRNA from November 15 to April 1, due to adverse weather and road conditions during this period.

The BRNA contains segments of two Forest trails. Trail #007 leads generally northward up an unnamed drainage from a point on the main road near the junction of Mill and Harmon Creeks. Trail #028 leads southwestward from the lowest switchback on the main road in the southwestern corner of the BRNA; only a very short segment of Trail #028 lies within the BRNA. Also, one can walk along an old, reclaimed road that forms a segment of the south-central boundary of the BRNA. This route affords the easiest access to the lower end of Chimney Hill.

Foot travel off of roads and trails within the BRNA is generally hindered by patches of the thick chaparral and mountain brush that distinguish this area. Travel is somewhat easier within the open ponderosa pine stands in the southeastern portion of the BRNA.

AREA BY COVER TYPES

The extent and distribution of vegetation cover types in the BRNA has been derived from field surveys and subsequent aerial photo interpretation. Several systems for classifying such types are considered, as discussed below.

The Society of American Foresters cover type classification (Eyre 1980) applies to portions of the BRNA that support coniferous forests and woodlands. The open forests of ponderosa pine, mostly in the southeastern part of the area, belong to SAF Type 237: Interior Ponderosa Pine. The woodlands of single-needle piñon pine and Utah juniper, principally in the north-central part of the area, belong to SAF Type 239: Pinyon-Juniper. The narrow riparian woodlands loosely correspond with SAF Type 235: Cottonwood-Willow, though no cottonwoods are present. The extensive mountain brush and chaparral communities of the BRNA are not considered in the SAF system.

The classification of potential natural vegetation by Kuchler (1966) applies somewhat more comprehensively to the vegetation of the BRNA. The open forests of ponderosa pine probably correspond to Type 17: Pine-Douglas fir Forest (though Douglas-fir is absent), or possibly to Type 18: Arizona Pine Forest. Piñon-juniper woodlands correspond to Type 21: Juniper-Pinyon Woodland. Chaparral communities of Dixie live oak and silk-tassel bush correspond to Type 29: Chaparral. Mountain brush communities of Gambel oak, birchleaf mahogany and serviceberry best correspond to Type 31: Mountain Mahogany-Oak Scrub. The narrow riparian woodlands do not appear to correspond to any Kuchler type.

The distribution of SAF cover types and K  chler types in the BRNA is shown on Map 5. The map legend displays the correspondence ("cross-walking") between these two broad classification schemes for forest types.

Beyond the SAF and K  chler classification systems, more-detailed descriptions of the BRNA's vegetation communities were made based on floristic composition observed during the field work in the area. These descriptions are contained in the **Flora and Communities** subsection of this Record.

Table 2 shows the estimated areas of vegetation types defined by the SAF and K  chler systems described above. As on Map 5, the correspondence between these two classification systems for forest types is displayed in the table.

Table 2. Estimated areas of SAF and K  chler types in the Browse RNA.

COVER TYPE	TYPE NUMBER		ESTIMATED AREA	
	SAF (1980)	K��chler (1966)	Acres	Hectares
Ponderosa pine	237	17 (18?)	230	93
Pi��n-juniper	239	21	370	150
Chaparral	---	29	265	107
Gambel oak, mountain brush	---	31	1250	506
Riparian woodland (velvet ash, water birch)	235	--	65	26
			TOTAL	2180 882

PHYSICAL AND CLIMATIC CONDITIONS

The BRNA encompasses portions of several valleys and intervening ridge crests within the foothills on the east side of the Pine Valley Mountains (Photos 1-4). These landforms are derived from largely westward-dipping sedimentary strata (sandstones, conglomerates, shales and limestones) that are covered in places by veneers of intrusive igneous rocks washed down from the core of the Pine Valley Mountains above to the west (Cook 1957; Cook 1960). Local relief within these valleys averages about 600-800 feet (180-245 m) from valley floor to adjacent ridge crest; slope gradients vary from gentle to very steep, mostly controlled by the position and resistance of the rock beds. Two perennial(?) streams enter the BRNA from the west and northwest (Harmon and Mill Creeks, respectively). These merge in the southeastern portion of the area, becoming South Ash Creek, which then flows through a narrow but relatively shallow gorge (Photo 4) out the southeastern corner of the BRNA.

Climate in the region of the BRNA is generally influenced by two different regimes that vary seasonally in their influence. During the winter months (November through March), storms move into the area from the west and account for over half of annual precipitation totals. Precipitation from these storms falls as rain in the valleys and snow in the mountains; the BRNA can receive either during the winter

depending on the coldness of the storm. Winter storms that reach this area from the Pacific Northwest and northern California tend to be drier than those that move in across southern California. During the summer, a weather pattern characterized by afternoon thunderstorms is common. These storms are typically spotty, though some can be locally intense, with heavy rainfall and high winds.

The National Weather Service (NWS) and USDA Natural Resources Conservation Service (NRCS) monitor climatic data at several installations surrounding the BRNA. Table 3 shows the name, record length, elevation, and location relative to the BRNA for five NRCS snotel sites and four NWS stations in the vicinity. Tables 4-6 contain average climatic data for these sites as posted on the internet. Those who use the BRNA for research may want to access these internet sites directly for climatic information, rather than relying on the summaries in Tables 4-6. The internet addresses are www.utdmp.utsnow.ncrcs.usda.gov for the NRCS snotel sites, and wrcc.sage.dri.edu (Western Regional Climate Center) for the NWS stations.

Table 3. Site data for climatic installations in the vicinity of the BRNA.

SITE NAME	RECORD LENGTH	ELEVATION	LOCATION RELATIVE TO BRNA
NRCS SNOTEL			
Kolob	1971-Present	9250 ft/2820 m	20 miles (32 km) to NE
Little Grassy	1985-Present	6100 ft/1860 m	29 miles (46 km) to WNW
Long Flat	1976-Present	8000 ft/2440 m	11 miles (18 km) to NNW
Midway Valley	1978-Present	9800 ft/2985 m	31 miles (50 km) to NE
Webster Flat	1977-Present	9220 ft/2810 m	28 miles (45 km) to NE
NWS STATIONS			
LaVerkin	1950-Present	3220 ft/980 m	12 miles (19 km) to SSE
New Harmony	1948-Present	5290 ft/1610 m	8 miles (13 km) to NNE
Veyo Powerhouse	1957-Present	4600 ft/1400 m	19 miles (30 km) to W
Zion National Park	1928-Present	4050 ft/1235 m	22 miles (35 km) to SE

Table 4. Average monthly precipitation data for five SNOTEL sites in the vicinity of the BRNA.

SITE NAME												
OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
KOLOB												
2.3 in 58 mm	2.9 in 74 mm	2.6 in 66 mm	3.7 in 94 mm	3.9 in 99 mm	5.8 in 147 mm	2.8 in 71 mm	1.9 in 48 mm	1.9 in 48 mm	1.6 in 41 mm	2.0 in 51 mm	1.9 in 48 mm	33.3 in 846 mm
LITTLE GRASSY												
1.5 in 38 mm	2.7 in 69 mm	2.2 in 56 mm	2.1 in 53 mm	4.2 in 107 mm	3.4 in 86 mm	1.4 in 36 mm	0.8 in 20 mm	0.4 in 10 mm	1.1 in 28 mm	1.7 in 43 mm	1.8 in 46 mm	23.3 in 592 mm
LONG FLAT												
1.8 in 46 mm	2.0 in 51 mm	2.0 in 51 mm	1.7 in 43 mm	2.9 in 74 mm	4.0 in 102 mm	2.0 in 51 mm	1.0 in 25 mm	0.5 in 13 mm	1.6 in 41 mm	2.2 in 56 mm	1.7 in 43 mm	23.4 in 594 mm
MIDWAY VALLEY												
2.5 in 64 mm	3.4 in 86 mm	2.9 in 74 mm	4.1 in 104 mm	4.7 in 119 mm	6.5 in 165 mm	3.2 in 81 mm	2.7 in 69 mm	2.1 in 53 mm	2.5 in 64 mm	2.8 in 71 mm	2.2 in 56 mm	39.6 in 1006 mm
WEBSTER FLAT												
2.3 in 58 mm	3.0 in 76 mm	2.6 in 66 mm	3.6 in 91 mm	3.8 in 97 mm	5.2 in 132 mm	3.3 in 84 mm	2.1 in 53 mm	1.4 in 36 mm	2.3 in 58 mm	3.0 in 76 mm	1.8 in 46 mm	34.4 in 874 mm

Table 5. Average monthly precipitation data for four NWS sites in the vicinity of the BRNA.

SITE NAME												
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
LA VERKIN												
1.40 in 36 mm	1.39 in 35 mm	1.58 in 40 mm	0.71 in 18 mm	0.53 in 13 mm	0.29 in 7 mm	0.73 in 19 mm	0.91 in 23 mm	0.81 in 21 mm	0.71 in 18 mm	1.00 in 25 mm	0.88 in 22 mm	10.94 in 278 mm
NEW HARMONY												
2.25 in 57 mm	2.19 in 56 mm	2.21 in 56 mm	1.16 in 29 mm	0.90 in 23 mm	0.54 in 14 mm	1.21 in 31 mm	1.55 in 39 mm	1.26 in 32 mm	1.18 in 30 mm	1.56 in 40 mm	1.56 in 40 mm	17.57 in 446 mm
VEYO POWERHOUSE												
1.37 in 35 mm	1.79 in 45 mm	2.11 in 54 mm	1.08 in 27 mm	0.78 in 20 mm	0.36 in 9 mm	0.82 in 21 mm	1.10 in 28 mm	1.10 in 28 mm	1.07 in 27 mm	1.30 in 33 mm	1.13 in 29 mm	14.00 in 356 mm
ZION NATIONAL PARK												
1.68 in 43 mm	1.78 in 45 mm	1.92 in 49 mm	1.13 in 29 mm	0.81 in 21 mm	0.47 in 12 mm	1.00 in 25 mm	1.47 in 37 mm	1.06 in 27 mm	0.99 in 25 mm	1.24 in 31 mm	1.38 in 35 mm	14.92 in 379 mm

Table 6. Average monthly maximum and minimum temperatures, and temperature extremes, for four NWS sites in the vicinity of the BRNA.

	SITE NAME											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
LA VERKIN												
52.9 F 11.6 C	59.0 F 15.0 C	65.3 F 18.5 C	73.9 F 23.3 C	83.3 F 28.5 C	93.5 F 34.2 C	98.3 F 36.8 C	96.2 F 35.7 C	89.1 F 31.7 C	77.9 F 25.5 C	62.8 F 17.1 C	53.6 F 12.0 C	75.5 F 24.2 C
26.0 F -3.3 C	30.8 F -0.7 C	36.1 F 2.3 C	41.6 F 5.3 C	48.9 F 9.4 C	56.7 F 13.7 C	64.0 F 17.8 C	63.1 F 17.3 C	55.0 F 12.8 C	43.5 F 6.4 C	32.5 F 0.3 C	25.9 F -3.4 C	43.7 F 6.5 C
TEMPERATURE EXTREMES: 113 F/45 C HIGH; -2 F/-19 C LOW												
NEW HARMONY												
44.7 F 7.1 C	49.2 F 9.6 C	54.7 F 12.6 C	63.2 F 17.3 C	72.7 F 22.6 C	83.3 F 28.5 C	88.8 F 31.6 C	86.6 F 30.3 C	79.5 F 26.4 C	68.5 F 20.3 C	54.7 F 12.6 C	46.1 F 7.8 C	66.1 F 18.9 C
20.8 F -6.2 C	24.3 F -4.3 C	28.6 F -1.9 C	34.2 F 1.2 C	42.1 F 5.6 C	50.8 F 10.4 C	58.4 F 14.7 C	57.2 F 14.0 C	49.3 F 9.6 C	38.9 F 3.8 C	28.2 F -2.1 C	21.7 F -5.7 C	37.9 F 3.3 C
TEMPERATURE EXTREMES: 104 F/40 C HIGH; -20 F/-29 C LOW												
VEYO POWERHOUSE												
46.9 F 8.3 C	51.8 F 11.0 C	57.0 F 13.9 C	65.3 F 18.5 C	75.2 F 24.0 C	86.2 F 30.1 C	92.5 F 33.6 C	90.3 F 32.4 C	82.7 F 28.2 C	71.4 F 21.9 C	57.0 F 13.9 C	48.5 F 9.2 C	68.8 F 20.4 C
24.2 F -4.3 C	28.2 F -2.1 C	32.0 F 0.0 C	37.8 F 3.2 C	45.4 F 7.4 C	53.6 F 12.0 C	59.5 F 15.3 C	58.2 F 14.6 C	51.3 F 10.7 C	41.7 F 5.4 C	30.8 F -0.7 C	24.8 F -4.0 C	40.7 F 4.8 C
TEMPERATURE EXTREMES: 107 F/42 C HIGH; -10 F/-23 C LOW												
ZION NATIONAL PARK												
51.5 F 10.8 C	56.9 F 13.8 C	63.7 F 17.6 C	72.6 F 22.6 C	82.6 F 28.1 C	93.5 F 34.2 C	99.4 F 37.4 C	96.8 F 36.0 C	90.0 F 32.2 C	77.8 F 25.4 C	62.7 F 17.1 C	52.9 F 11.6 C	75.1 F 23.9 C
28.7 F -1.8 C	32.8 F 0.4 C	36.9 F 2.7 C	43.5 F 6.4 C	52.0 F 11.1 C	61.3 F 16.3 C	68.5 F 20.3 C	67.1 F 19.5 C	60.2 F 15.7 C	49.2 F 9.6 C	36.8 F 2.7 C	30.0 F -1.1 C	47.3 F 8.5 C
TEMPERATURE EXTREMES: 115 F/46 C HIGH; -15 F/-26 C LOW												

DESCRIPTION OF VALUES

Flora and Communities

Table 7 lists plant species in the BRNA. Scientific nomenclature follows Welsh et al. (1993), with some commonly-used synonyms included in Table 7 where appropriate. Nomenclature for trees agrees with Little (1979).

The BRNA contains no plants federally listed as endangered or threatened. One plant considered sensitive by Region Four of the USDA Forest Service, *Astragalus zionis* var. *vigulus* (guard milkvetch), occurs along the road to the Browse Guard Station north of Harmon Creek, in the southwestern and western parts of the area.

Five types of plant communities defined by existing vegetation were identified in the BRNA (see Table 7). These are described in more detail below.

A. *Garrya flavescens*-*Quercus turbinella*-*Arctostaphylos pungens* (silk-tassel bush-Dixie live oak-Mexican manzanita) evergreen chaparral communities.

The hard-leaved evergreen chaparral type occurs on relatively level positions, plus south- and east-facing slopes, generally scattered across the southern quarter of the BRNA (Photos 5 and 6). It appears to be best developed on substrates derived from unconsolidated igneous materials transported from the core of the Pine Valley Mountains to the west. These communities also occur on several of the sedimentary formations present within the area.

The chaparral type consists of shrubs that average about 4-6 feet (1.2-1.8 m) in height. Their density and stiffness combine to form a shrub thicket that in many places is not easily traversed on foot. Characteristic shrub species are *Garrya flavescens* and *Quercus turbinella* (Photo 7), along with *Arctostaphylos pungens* (Photo 6) and *Ceanothus greggii*. Shrubs characteristic of other communities may also be present in lesser amounts within the chaparral vegetation; these include *Amelanchier utahensis*, *Cercocarpus montanus*, *Quercus gambelii*, *Artemisia tridentata* and *Purshia tridentata*. Some stands of the chaparral type are dotted with scattered *Juniperus osteosperma* and *Pinus monophylla* trees, probably reflecting conditions transitional to purer piñon-juniper woodlands.

Spaces between the shrubs support herbaceous understory vegetation. Common grasses include *Poa fendleriana*, *Stipa comata*, *Elymus elymoides* and *Stipa speciosa*. Typical forbs include *Arenaria macradenia*, *Asclepias asperula*, *Astragalus straturensis*, *Eriogonum umbellatum*, *Penstemon palmeri* and *Penstemon rostriflorus*. Few exotic plants such as *Bromus tectorum* were seen in the understories of these chaparral communities.

Wells (1960) mentions that this type is similar to the chaparral of central Arizona. Further, with the notable exception of the genus *Adenostoma* (chamise), this Utah chaparral contains most of the dominant genera of the California chaparral. On the southeastern flank of the Pine Valley Mountains, the evergreen chaparral largely usurps the zone usually occupied in southern Utah by piñon-juniper/sagebrush vegetation.

B. *Amelanchier utahensis*-*Cercocarpus montanus*-*Quercus gambelii* (Utah serviceberry-birchleaf mountain mahogany-Gambel oak) mountain brush communities.

These tall-shrub communities occupy slopes of various aspects at middle and upper elevations of the BRNA. They comprise the most extensive type of vegetation within the area, being present and well-developed in all but the southeastern portion of the RNA. These communities appear to occur on sites

Table 7. Plant species in the Browse Research Natural Area.

LIFE FORM Scientific name ¹ [Synonym, if any] (common name)	Plant community ²				
	A	B	C	D	E
TREES³					
<i>Acer grandidentatum</i> (bigtooth maple)					X
<i>Acer negundo</i> (boxelder)					X
<i>Fraxinus velutina</i> (velvet ash)					X
<i>Juniperus osteosperma</i> (Utah juniper)	X	X	X	X	
<i>Pinus monophylla</i> (singleleaf piñon pine)	X		X	X	
<i>Pinus ponderosa</i> (ponderosa pine)					X
SHRUBS AND SUBSHRUBS					
<i>Amelanchier utahensis</i> (Utah serviceberry)	X	X	X	X	
<i>Arctostaphylos patula</i> (greenleaf manzanita)					X
<i>Arctostaphylos pungens</i> (Mexican manzanita)	X		X	X	
<i>Artemisia tridentata</i> (big sagebrush)	X	X	X	X	
* <i>Betula occidentalis</i> (water birch)					X
<i>Ceanothus greggii</i> (Gregg's ceanothus)	X	X	X	X	
<i>Cercocarpus intricatus</i> (dwarf mountain mahogany)	X				X
<i>Cercocarpus ledifolius</i> (curlleaf mountain mahogany)				X	X
<i>Cercocarpus montanus</i> (birchleaf mountain mahogany)	X	X			X
<i>Chrysothamnus nauseosus</i> (rubber rabbitbrush)					X
<i>Chrysothamnus viscidiflorus</i> (viscid rabbitbrush)			X		
* <i>Cornus sericea</i> (red-osier dogwood)					X
<i>Eriodictyon angustifolium</i> (yerba santa)	X				
* <i>Fraxinus anomala</i> (single-leaf ash)	X	X	X	X	
<i>Garrya flavescens</i> (silk-tassel bush)	X				X
<i>Gutierrezia microcephala</i> (thread snakeweed)					X
<i>Gutierrezia sarothrae</i> (broom snakeweed)	X				
<i>Haplopappus scabiflorus</i> (spindly goldenbush)	X				X
* <i>Holodiscus dumosus</i> (mountain spray)	X				
* <i>Pachistima myrsinoides</i> (mountain lover)	X				
<i>Prunus virginiana</i> (chokecherry)					X
<i>Purshia tridentata</i> (bitterbrush)	X		X	X	
<i>Quercus gambelii</i> (Gambel oak)		X	X	X	
<i>Quercus turbinella</i> (Dixie live oak)	X		X	X	
* <i>Rhus aromatica</i> var. <i>trilobata</i> (skunkbush)					X
<i>Rosa woodsii</i> (Woods rose)					X
* <i>Rubus discolor</i> (Himalayan blackberry)					X
<i>Salix</i> sp. {to 2 m. tall} (willow)					X
<i>Salix</i> sp. {to 4 m. tall} (willow)					X
<i>Tetradymia canescens</i> (gray horsebrush)					
GRAMINOIDS					
<i>Agropyron cristatum</i> (crested wheatgrass)			X		
* <i>Agrostis stolonifera</i> (reddtop)					X
* <i>Aristida purpurea</i> (purple threeawn)					X

Table 7 (Continued). Plant species in the Browse Research Natural Area.

LIFE FORM Scientific name ¹ [Synonym, if any] (common name)	Plant community ²				
	A	B	C	D	E
GRAMINOIDS (CONTINUED)					
<i>Bouteloua gracilis</i> (blue grama)		X		X	
<i>Bromus inermis</i> (smooth brome)		X			
<i>Bromus rubens</i> (red brome)				X	
<i>Bromus tectorum</i> (cheatgrass)	X				
* <i>Carex aurea</i> (golden sedge)					X
<i>Carex occidentalis</i> (western sedge)	X				
* <i>Carex hystricina</i> (bottlebrush sedge)					X
<i>Carex rossii</i> (?) (Ross sedge)	X		X		
* <i>Dactylis glomerata</i> (orchardgrass)					X
* <i>Eleocharis palustris</i> (common spikerush)					X
<i>Elymus elymoides</i> [<i>Sitanion hystrix</i>] (squirreltail)	X	X		X	
<i>Elymus lanceolatus</i> (thickspike wheatgrass)	X				X
<i>Elymus smithii</i> [<i>Agropyron smithii</i>] (western wheatgrass)	X				
<i>Festuca octoflora</i> (sixweeks fescue)	X			X	
* <i>Juncus arcticus</i> [<i>Juncus balticus</i>] (Baltic rush)					X
* <i>Juncus ensifolius</i> (swordleaf rush)					X
* <i>Juncus torreyi</i> (Torrey's rush)					X
<i>Koeleria macrantha</i> (junegrass)				X	
* <i>Panicum oligosanthes</i> (Scribner's panic grass)					X
<i>Poa fendleriana</i> (mutton grass)	X	X		X	
<i>Poa pratensis</i> (Kentucky bluegrass)					X
<i>Schizachyrium scoparium</i> (little bluestem)		X			
* <i>Scirpus microcarpus</i> (panicled bulrush)					X
<i>Sporobolus cryptandrus</i> (sand dropseed)				X	
<i>Stipa comata</i> (needle-and-thread)	X			X	
<i>Stipa hymenoides</i> [<i>Oryzopsis hymenoides</i>] (Indian ricegrass)		X		X	
<i>Stipa speciosa</i> (desert needlegrass)	X				
FORBS AND SUCCULENTS					
<i>Allium acuminatum</i> (acuminate onion)	X	X		X	
<i>Angelica pinnata</i> (small-leaved angelica)					X
* <i>Antennaria parvifolia</i> (common pussytoes)	X				
* <i>Apocynum cannabinum</i> (dogbane)					X
* <i>Aquilegia formosa</i> (western columbine)					X
* <i>Arenaria macradenia</i> (shrubby sandwort)	X			X	
<i>Artemisia ludoviciana</i> (Louisiana wormwood)				X	
<i>Asclepias asperula</i> (spider milkweed)	X	X			
* <i>Asclepias tuberosa</i> (butterfly weed)					X
<i>Aster chilensis</i> ssp. <i>adscendens</i> (Pacific aster)		X			
<i>Astragalus amphioxys</i> (crescent milkvetch)		X			
* <i>Astragalus straturensis</i> (Silver Reef milkvetch)	X	X			
<i>Astragalus zionis</i> var. <i>vigulus</i> (guard milkvetch)		X			
<i>Balsamorhiza sagittata</i> (arrowleaf balsamroot)		X			

Table 7 (Continued). Plant species in the Browse Research Natural Area.

LIFE FORM Scientific name ¹ [Synonym, if any] (common name)	Plant community ²				
	A	B	C	D	E
FORBS AND SUCCULENTS (CONTINUED)					
<i>Calochortus nuttallii</i> (segog lily)		X		X	
<i>Castilleja scabrida</i> (Eastwood's paintbrush)		X		X	
<i>Chenopodium ambrosioides</i> (Mexican tea)					X
* <i>Cirsium arizonicum</i> (Arizona thistle)	X			X	
<i>Clematis ligusticifolia</i> (white virgin's-bower)					X
<i>Collomia linearis</i> (small collomia)		X			
<i>Collomia grandiflora</i> (large collomia)		X			
<i>Comandra umbellata</i> (bastard toadflax)	X	X		X	
<i>Crepis occidentalis</i> (western hawksbeard)		X		X	
* <i>Cymopterus purpureus</i> var. <i>rosei</i> (Rose spring parsley)	X	X			
<i>Dalea searlsiae</i> (Searls prairie clover)		X			
<i>Descurainia pinnata</i> (pinnate tansymustard)	X				
<i>Echinocereus engelmannii</i> (Engelmann hedgehog cactus)	X				X
<i>Epilobium brachycarpum</i> (autumn willowherb)	X				
<i>Equisetum arvense</i> (meadow horsetail)					X
<i>Equisetum laevigatum</i> (smooth scouring rush)					X
* <i>Erigeron divergens</i> var. <i>cineratus</i> (spreading daisy)					X
<i>Erigeron divergens</i> var. <i>divergens</i> (spreading daisy)					X
* <i>Erigeron pumilus</i> (vernal daisy)	X			X	
<i>Erigeron jonesii</i> (Jones' daisy)		X			
* <i>Erigeron utahensis</i> (Utah daisy)	X				X
* <i>Eriogonum davidsonii</i> (Davidson's buckwheat)	X				
<i>Eriogonum racemosum</i> (redroot buckwheat)	X	X		X	
<i>Eriogonum umbellatum</i> var. <i>subaridum</i> (arid buckwheat)	X	X		X	
<i>Euphorbia albomarginata</i> (rattlesnake weed)	X				
<i>Fritillaria atropurpurea</i> (leopard lily)			X		
* <i>Galium multiflorum</i> (shrubby bedstraw)	X				
<i>Gayophytum diffusum</i> (diffuse groundsmoke)		X			
<i>Gilia aggregata</i> (scarlet gilia)		X			
* <i>Gilia congesta</i> var. <i>frutescens</i> (shrubby gilia)		X			
<i>Gilia inconspicua</i> (floccose gilia)		X			
* <i>Gilia leptomeria</i> var. <i>micromeria</i> (common gilia)	X				
* <i>Habenaria sparsiflora</i> (Watson's bog orchid)					X
<i>Heterotheca villosa</i> (hairy goldenaster)				X	
* <i>Heuchera parvifolia</i> (littleleaf alumroot)	X	X			
<i>Heuchera rubescens</i> (red alumroot)				X	
<i>Hymenopappus filifolius</i> (hyaline herb)	X			X	
* <i>Hymenoxys cooperi</i> (Cooper's hymenoxys)	X	X			
<i>Lactuca serriola</i> (prickly lettuce)	X				
<i>Linum perenne</i> (blue flax)			X		
<i>Lomatium scabrum</i> (rough lomatium)	X				X
* <i>Lotus denticulatus</i> (mohave trefoil)	X				
<i>Lotus humistratus</i> (low trefoil)					

Table 7 (Continued). Plant species in the Browse Research Natural Area.

LIFE FORM Scientific name ¹ [Synonym, if any] (common name)	Plant community ²				
	A	B	C	D	E
FORBS AND SUCCULENTS (CONTINUED)					
<i>Lotus utahensis</i> (Utah trefoil)	X	X			
* <i>Lupinus argenteus</i> (silvery lupine)	X				
* <i>Lupinus sericeus</i> var. <i>barbiger</i> (sink lupine)	X				
<i>Machaeranthera canescens</i> (hoary aster)			X		
<i>Medicago lupulina</i> (hop clover)					X
<i>Medicago sativa</i> (alfalfa)					X
<i>Melilotus officinalis</i> (yellow sweetclover)					X
* <i>Mimulus guttatus</i> (common monkeyflower)					X
<i>Monardella odoratissima</i> (horsemint)				X	
* <i>Nasturtium officinale</i> (water cress)					X
* <i>Nicotiana attenuata</i> (coyote tobacco)	X	X			
<i>Oenothera caespitosa</i> (tufted evening primrose)		X			
* <i>Oenothera elata</i> (Hooker's evening primrose)					X
<i>Opuntia macrorhiza</i> (plains pricklypear)	X	X		X	
<i>Opuntia phaeacantha</i> (berry pricklypear)	X	X			
<i>Pellaea glabella</i> (cliff-brake)					X
<i>Penstemon eatonii</i> (Eaton's penstemon)	X				X
* <i>Penstemon leonardii</i> var. <i>higginsii</i> (Higgins' penstemon)	X	X			X
<i>Penstemon linarioides</i> var. <i>sileri</i> (Siler's penstemon)		X			
<i>Penstemon palmeri</i> (Palmer's penstemon)	X	X			
* <i>Penstemon rostriflorus</i> (Bridges' penstemon)	X	X			X
<i>Petradoria pumila</i> (rock goldenrod)	X				X
<i>Phlox austromontana</i> (desert phlox)		X			X
<i>Phoradendron juniperinum</i> (juniper mistletoe)			X		X
<i>Physaria newberryi</i> (Newberry's twinpod)	X				
<i>Polygonum aviculare</i> (knotweed)					X
<i>Psoralidium tenuiflorum</i> (prairie scurfpea)		X			
* <i>Sanguisorba minor</i> (burnet)					X
<i>Senecio multilobatus</i> (Uinta groundsel)	X	X		X	
<i>Sisymbrium altissimum</i> (tumble mustard)					X
<i>Smilacina stellata</i> (stellate smilacina)					X
<i>Solidago canadensis</i> (goldenrod)					X
<i>Stephanomeria pauciflora</i> (fewflower wirelettuce)				X	
* <i>Thalictrum fendleri</i> (Fendler meadowrue)					X
<i>Thelypodium integrifolium</i> (tall thelypody)					X
<i>Trifolium macilentum</i> (lean clover)	X				
<i>Verbena bracteata</i> (prostrate vervain)					X
* <i>Vicia americana</i> (American vetch)		X			X
<i>Yucca utahensis</i> (Utah yucca)	X		X	X	
<i>Zigadenus paniculatus</i> (foothills death camas)		X			

Table 7 (Continued). Plant species in the Browse Research Natural Area.

NOTES:

1. Scientific nomenclature follows: Welsh, S.L., N.D. Atwood, S. Goodrich, and L.C. Higgins, eds. 1993. A Utah flora, second edition. Brigham Young University, Provo, UT. 986 p.
2. Plant communities:
 - A. *Garrya flavescens*-*Quercus turbinella*-*Arctostaphylos pungens* evergreen chaparral communities.
 - B. *Amelanchier utahensis*-*Cercocarpus montanus*-*Quercus gambelii* mountain brush communities.
 - C. *Pinus monophylla*-*Juniperus osteosperma* woodland communities.
 - D. *Pinus ponderosa* open forest communities.
 - E. *Fraxinus velutina*-*Betula occidentalis* riparian woodland communities.
3. Nomenclature for trees follows: Little, E.L., Jr. 1979. Checklist of United States trees. USDA Forest Service Agricultural Handbook 541. 375 p.

* Collected and deposited in regional herbaria.

that are relatively more moist and cool than those of the evergreen chaparral, and seem more confined to substrates derived from sedimentary formations.

The vegetation consists of stands of tall shrubs, among which *Amelanchier utahensis*, *Cercocarpus montanus* and *Quercus gambelii* are the most abundant (Photo 8). These three species are characteristic of "mountain brush" vegetation that is common across much of southern Utah. Other shrubs that may occur in these communities include *Artemisia tridentata*, *Chrysothamnus viscidiflorus*, and *Fraxinus anomala*. Scattered *Juniperus osteosperma* and *Pinus monophylla* trees are occasionally present as well.

The cover and diversity of understory species vary inversely with the density of the overstory shrubs. Grasses such as *Poa fendleriana*, *Elymus elymoides* and *Stipa hymenoides* are probably present in many of these communities. One site seen during field inventories contained a rich mix of 27 forb species; this was a relatively open shrubland, however, and fewer forbs would be expected to occur on sites where the shrubs are more dense.

C. *Pinus monophylla*-*Juniperus osteosperma* (single needle piñon pine-Utah juniper) woodland communities.

Piñon-juniper woodlands of the BRNA (Photo 9) are best developed on the crest and upper slopes of the major ridge trending south from Coal Hill, in the north-central part of the area. Their presence in this location appears to be closely associated with the Dakota/Tropic (undivided), Entrada and Carmel Formations as mapped by Cook (1957, 1960). More-sparse woodlands of piñon and juniper occupy the steep east-facing exposure of Navajo Sandstone adjacent to the eastern boundary of the BRNA.

The vegetation consists of open woodlands of *Pinus monophylla* and *Juniperus osteosperma*. No piñon-juniper stands were traversed directly during the field inventories. From a distance, however, associated species appeared to be many of the mountain-brush and/or chaparral shrubs (see communities B and C above), though probably not with the density of those shrub types in their purer

forms. Boundaries between the piñon-juniper woodlands and these other vegetation communities are largely diffuse and indistinct.

Wells (1960), however, noted a fairly distinct transition between chaparral shrub vegetation and piñon-juniper woodland on the east side of the Pine Valley Mountains, even where substrate (high level gravel) was continuous. He notes that the fairly narrow transition zone between these two types appears to be a zone of competition between physiologically incompatible vegetation types. Difference in substrate may also contribute to this fairly distinct transition. As mentioned above, piñon-juniper woodlands seem to be best developed on certain sedimentary strata, whereas the chaparral tends to dominate on unconsolidated igneous materials that mantle the sedimentary rocks.

D. *Pinus ponderosa* (ponderosa pine) open forest communities.

The most extensive examples of ponderosa pine communities occur in the southeastern portion of the BRNA, on exposures of the Navajo Sandstone northeast of South Ash Creek. Other small stands of ponderosa pine occur in the valley bottoms of Mill Creek (especially the stretch below the Browse Guard Station) and Harmon Creek.

On the Navajo Sandstone outcrops, these communities (Photo 10) consist of open stands of *Pinus ponderosa* with some *Pinus monophylla* and *Juniperus osteosperma* also present. *Arctostaphylos pungens* is the most conspicuous component of the understory. Many other shrubs are scattered throughout these stands, including those typical of the evergreen chaparral type (*Garrya flavescens*, *Quercus turbinella*, *Ceanothus greggii*) and the mountain brush type (*Amelanchier utahensis*, *Cercocarpus montanus*, *Quercus gambelii*). A rich herbaceous species mix is also present, with 8 graminoids and 29 forbs seen in one stand of this type during the field inventory. The composition of these stands does not match well with any of the *Pinus ponderosa* habitat types described by Youngblood and Mauk (1985).

E. *Fraxinus velutina-Betula occidentalis* (velvet ash-water birch) riparian woodland communities.

Riparian communities occur along the banks of Mill, Harmon and South Ash Creeks. One example of this type was seen during the field inventory, in the area where Mill and Harmon Creeks join (Photo 11). This community is a woodland up to 15 feet (4.5 m) tall, in which *Fraxinus velutina* and *Betula occidentalis* are the most abundant species. Other shrubs or small trees present include *Acer negundo*, *Cornus sericea*, *Prunus virginiana*, *Rosa woodsii* and at least two *Salix* spp. Among the graminoids at this site are *Poa pratensis*, *Juncus ensifolius* and *Scirpus microcarpus*. Forbs that were seen include *Angelica pinnata*, *Aquilegia formosa*, *Clematis ligusticifolia*, *Equisteum arvense*, *Equisteum laevigatum*, *Habenaria sparsiflora* and *Smilacina stellata*. Also present are a number of exotic species, particularly *Dactylis glomerata* and *Melilotus officinalis*, which reflect the influence of human uses (e.g. camping, stock use, roads) that have occurred in these valley bottom areas.

Fauna [Compiled by Priscilla Summers, Wildlife Biologist, Pine Valley and Cedar City Ranger Districts]

Only one Federally listed threatened, endangered, candidate or proposed species is known or likely to be present within the BRNA: the peregrine falcon (*Falco peregrinus anatum*). Sensitive species that could occur or are known to occur include:

Spotted bat	<i>Euderma maculatum</i>
Townsend's big-eared bat	<i>Corynorhinus townsendii</i>
Flammulated owl	<i>Otus flammeeolus</i>
Northern goshawk	<i>Accipiter gentilis</i>
Bonneville cutthroat trout	<i>Oncorhynchus clarki utah</i>

Management indicator species identified in the Forest Plan (USDA Forest Service 1986b) within the BRNA include:

Mule Deer	<i>Odocoileus hemionus</i>
Northern Goshawk	<i>Accipiter gentilis</i>
Northern (Red-shafted) Flicker	<i>Colaptes auratus</i>
Wild Turkey	<i>Meleagris gallopavo</i>

The area occupied by the BRNA is considered to be transition range for mule deer. Deer numbers in this general area are down considerably from historic highs that were reached in the 1950s. Other species of interest within the BRNA are the following bats:

Hoary bat	<i>Lasiurus cinereus</i>
Long-legged bat	<i>Myotis volans</i>
Fringed myotis	<i>Myotis thysanodes</i>
Big brown bat	<i>Eptesicus fuscus</i>
Silvery-haired bat	<i>Lasionycteris noctivigans</i>

Tables 8-10 contain general list of birds, mammals, and reptiles/amphibians (respectively) that are known or likely to be present within the BRNA. A list of butterfly species recorded in Washington County is available on the internet, at www.npwrc.usgs.gov. This list is not presented here because it includes all butterflies in the whole county, which contains a much wider variety of habitats those just in the BRNA.

Geology

Geologic work in the region containing the BRNA includes the reconnaissance mapping of Cook (1957, 1960), and the detailed mapping of Grant (1995) which covers the northern third of the BRNA at a fine scale. The following information draws extensively from these sources, noting differences between them where appropriate.

The main mass of the Pine Valley range is formed by the Pine Valley laccolith, a body of intrusive igneous rocks (monzonite porphyry) of Tertiary age that uplifted and upfaulted pre-existing ("roofing") sedimentary rocks. Erosion has removed the cover of this laccolith, leaving the core that now forms the high peaks of the Pine Valley Mountains several miles to the west of the BRNA.

The BRNA itself is underlain primarily by a sequence of mostly westward-dipping sedimentary strata of Jurassic and Cretaceous age. The lowermost of these within the BRNA is the Navajo Sandstone of Jurassic age. The Navajo is a tan to reddish, massive cross-bedded sandstone of aeolian origin that is exposed in much of the southeastern quadrant of the area. It forms the mostly-level bench between South Ash Creek and Dry Wash in the extreme southeastern tip of the area, and also forms much of the high, north-south-trending ridge to the northwest of this bench. Open stands of ponderosa pine appear to be mostly restricted to outcrops of the Navajo Sandstone within the BRNA.

Overlying the Navajo Sandstone, and separated from it by a disconformity, is the Carmel Formation of upper Jurassic age. Cook (1957) states that the Carmel in this vicinity generally consists, from bottom to top, of red friable sandstone (probably representing Navajo Sandstone material reworked by an advancing Jurassic sea); gypsiferous shale and gypsum; gray and brown arenaceous limestone; and platy, argillaceous gray limestone. Grant (1995) interprets the Carmel sequence as a lower red siltstone; a middle thick platy gray argillaceous micrite limestone; and an upper thin red siltstone and sandstone. Within the BRNA, the Carmel Formation is exposed in the bottom and sides of the drainage traversed by Trail #007 (in the northeastern part of the area), where it largely supports oak-mahogany-serviceberry and chaparral vegetation.

Table 8. Birds known or likely to occur within the Browse Research Natural Area.

ORDER	Family	Common Name	Scientific Name
FALCONIFORMES			
	Accipitridae		
	Osprey		<i>Pandion haliaetus</i>
	Bald Eagle		<i>Haliaeetus leucocephalus</i>
	Northern Harrier		<i>Circus cyaneus</i>
	Sharp-shinned Hawk		<i>Accipiter striatus</i>
	Cooper's Hawk		<i>Accipiter cooperii</i>
	Northern Goshawk		<i>Accipiter gentilis</i>
	Swainson's Hawk		<i>Buteo swainsoni</i>
	Red-tailed Hawk		<i>Buteo jamaicensis</i>
	Ferruginous Hawk		<i>Buteo regalis</i>
	Golden Eagle		<i>Aquila chrysaetos</i>
	Falconidae		
	American Kestrel		<i>Falco sparverius</i>
	Merlin		<i>Falco columbarius</i>
	Peregrine Falcon		<i>Falco peregrinus</i>
GALLIFORMES			
	Phasianidae		
	Wild Turkey		<i>Meleagris gallopavo</i>
	Odontophoridae		
	Gambel's Quail		<i>Callipepla gambelii</i>
CHARADRIIFORMES			
	Laridae		
	Ring-billed Gull		<i>Larus delawarensis</i>
	California Gull		<i>Larus californicus</i>
COLUMBIFORMES			
	Columbidae		
	Band-tailed Pigeon		<i>Columba fasciata</i>
	Mourning Dove		<i>Zenaida macroura</i>
CUCULIFORMES			
	Cuculidae		
	Greater Roadrunner		<i>Geococcyx californianus</i>

Table 8 (Continued). Birds known or likely to occur within the Browse Research Natural Area.

ORDER

Family

Common Name

Scientific Name

STRIGIFORMES

Strigidae

Flammulated Owl	<i>Otus flammelous</i>
Western Screech-Owl	<i>Otus kennicottii</i>
Great Horned Owl	<i>Bubo virginianus</i>
Northern Pygmy-Owl	<i>Glaucidium gnoma</i>
Saw-whet Owl	<i>Aegolius acadicus</i>

CAPRIMULGIFORMES

Caprimulgidae

Common Nighthawk	<i>Chordeiles minor</i>
Common Poorwill	<i>Phalaenoptilus nuttallii</i>

APODIFORMES

Apodidae

White-throated Swift	<i>Aeronautes saxatalis</i>
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Trochilidae

Black-chinned Hummingbird	<i>Archilochus alexandri</i>
Calliope Hummingbird	<i>Stellula calliope</i>
Rufous Hummingbird	<i>Selasphorus rufus</i>

CORACIIFORMES

Alcedinidae

Belted Kingfisher	<i>Ceryle alcyon</i>
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PICIFORMES

Picidae

Lewis's Woodpecker	<i>Melanerpes lewis</i>
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>
Williamson's Sapsucker	<i>Sphyrapicus thyroideus</i>
Downy Woodpecker	<i>Picoides pubescens</i>
Hairy Woodpecker	<i>Picoides villosus</i>
Northern Flicker	<i>Colaptes auratus</i>

Table 8 (Continued). Birds known or likely to occur within the Browse Research Natural Area.

ORDER

Family	Common Name	Scientific Name
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PASSERIFORMES		
Tyrannidae		
Olive-sided Flycatcher	<i>Contopus cooperi</i>	
Western Wood-Pewee	<i>Contopus sordidulus</i>	
Hammond's Flycatcher	<i>Empidonax hammondi</i>	
Dusky Flycatcher	<i>Empidonax oberholseri</i>	
Gray Flycatcher	<i>Empidonax wrightii</i>	
Cordilleran Flycatcher	<i>Empidonax occidentalis</i>	
Say's Phoebe	<i>Sayornis saya</i>	
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>	
Western Kingbird	<i>Tyrannus verticalis</i>	
Laniidae		
Loggerhead Shrike	<i>Lanius ludovicianus</i>	
Vireonidae		
Gray Vireo	<i>Vireo vicinior</i>	
Cassin's Vireo	<i>Vireo cassini</i>	
Plumbeous Vireo	<i>Vireo plumbeus</i>	
Warbling Vireo	<i>Vireo gilvus</i>	
Corvidae		
Steller's Jay	<i>Cyanocitta stelleri</i>	
Western Scrub-Jay	<i>Aphelocoma californica</i>	
Pinyon Jay	<i>Gymnorhinus cyanocephalus</i>	
Clark's Nutcracker	<i>Nucifraga columbiana</i>	
Common Raven	<i>Corvus corax</i>	
Hirundinidae		
Tree Swallow	<i>Tachycineta bicolor</i>	
Violet-green Swallow	<i>Tachycineta thalassina</i>	
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	
Barn Swallow	<i>Hirundo rustica</i>	
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	
Paridae		
Black-capped Chickadee	<i>Poecile atricapillus</i>	
Mountain Chickadee	<i>Poecile gambeli</i>	
Juniper Titmouse	<i>Baeolophus ridgwayi</i>	
Aegithalidae		
Bushtit	<i>Psaltriparus minimus</i>	

Table 8 (Continued). Birds known or likely to occur within the Browse Research Natural Area.

ORDER

Family	Common Name	Scientific Name
PASSERIFORMES		
Sittidae		
Red-breasted Nuthatch		<i>Sitta canadensis</i>
White-breasted Nuthatch		<i>Sitta carolinensis</i>
Pygmy Nuthatch		<i>Sitta pygmaea</i>
Certhiidae		
Brown Creeper		<i>Certhia americana</i>
Troglodytidae		
Rock Wren		<i>Salpinctes obsoletus</i>
Canyon Wren		<i>Catherpes mexicanus</i>
Bewick's Wren		<i>Thryomanes bewickii</i>
House Wren		<i>Troglodytes aedon</i>
Winter Wren		<i>Troglodytes troglodytes</i>
Cinclidae		
American Dipper		<i>Cinclus mexicanus</i>
Sylviidae		
Blue-gray Gnatcatcher		<i>Polioptila caerulea</i>
Regulidae		
Golden-crowned Kinglet		<i>Regulus satrapa</i>
Ruby-crowned Kinglet		<i>Regulus calendula</i>
Turdidae		
Western Bluebird		<i>Sialia mexicana</i>
Mountain Bluebird		<i>Sialia currucoides</i>
Townsend's Solitaire		<i>Myadestes townsendi</i>
Hermit Thrush		<i>Catharus guttatus</i>
American Robin		<i>Turdus migratorius</i>
Mimidae		
Northern Mockingbird		<i>Mimus polyglottos</i>
Sage Thrasher		<i>Oreoscoptes montanus</i>
Bombycillidae		
Cedar Waxwing		<i>Bombycilla cedrorum</i>
Oxyruncidae		
Phainopepla		<i>Phainopepla nitens</i>

Table 8 (Continued). Birds known or likely to occur within the Browse Research Natural Area.

ORDER

Family

Common Name

Scientific Name

PASSERIFORMES

Parulidae

Orange-crowned Warbler	<i>Vermivora celata</i>
Nashville Warbler	<i>Vermivora ruficapilla</i>
Virginia's Warbler	<i>Vermivora virginiae</i>
Lucy's Warbler	<i>Vermivora luciae</i>
Northern Parula	<i>Parula americana</i>
Yellow Warbler	<i>Dendroica petechia</i>
Yellow-rumped Warbler	<i>Dendroica coronata</i>
Black-throated Gray Warbler	<i>Dendroica nigrescens</i>
Townsend's Warbler	<i>Dendroica townsendi</i>
Grace's Warbler	<i>Dendroica graciae</i>
MacGillivray's Warbler	<i>Oporornis tolmiei</i>
Wilson's Warbler	<i>Wilsonia pusilla</i>
Yellow-breasted Chat	<i>Icteria virens</i>

Thraupidae

Western Tanager	<i>Piranga ludoviciana</i>
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Emberizidae

Green-tailed Towhee	<i>Pipilo chlorurus</i>
Spotted Towhee	<i>Pipilo maculatus</i>
Chipping Sparrow	<i>Spizella passerina</i>
Brewer's Sparrow	<i>Spizella breweri</i>
Black-chinned Sparrow	<i>Spizella troglodytes</i>
Vesper Sparrow	<i>Pooecetes gramineus</i>
Lark Sparrow	<i>Chondestes grammacus</i>
Black-throated Sparrow	<i>Amphispiza bilineata</i>
Song Sparrow	<i>Melospiza melodia</i>
Lincoln's Sparrow	<i>Melospiza lincolni</i>
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>
Dark-eyed Junco	<i>Junco hyemalis</i>

Cardinalidae

Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>
Blue Grosbeak	<i>Guiraca caerulea</i>
Lazuli Bunting	<i>Passerina amoena</i>
Indigo Bunting	<i>Passerina cyanea</i>

Table 8 (Continued). Birds known or likely to occur within the Browse Research Natural Area.

ORDER

Family

Common Name

Scientific Name

PASSERIFORMES

Icteridae

Western Meadowlark
Brewer's Blackbird
Brown-headed Cowbird
Bullock's Oriole

Sturnella neglecta
Euphagus cyanocephalus
Molothrus ater
Icterus bullockii

Fringillidae

Pine Grosbeak
Cassin's Finch
House Finch
Red Crossbill
Pine Siskin
Lesser Goldfinch
American Goldfinch
Evening Grosbeak

Pinicola enucleator
Carpodacus cassini
Carpodacus mexicanus
Loxia curvirostra
Carduelis pinus
Carduelis psaltria
Carduelis tristis
Coccothraustes vespertinus

Table 9. Mammals known or likely to occur within the Browse Research Natural Area.

Common Name	Scientific Name	Occurs	Probably Occurs	May Occur
Short-tailed Weasel	<i>Mustela erminea</i>		X	
Long-tailed Weasel	<i>Mustela frenata</i>		X	
Spotted Skunk	<i>Spilogale putorius</i>			X
Striped Skunk	<i>Mephitis mephitis</i>			X
Red Fox	<i>Vulpes fulva</i>			X
Gray Fox	<i>Urocyon cinereoargenteus</i>		X	
Coyote	<i>Canis latrans</i>		X	
Mountain Lion	<i>Felis concolor</i>	X		
Bobcat	<i>Lynx rufus</i>		X	
Yellow-bellied Marmot	<i>Marmota flaviventris</i>			X
Ringtail	<i>Bassariscus astutus</i>			X
Badger	<i>Taxidea taxus</i>			X
Red Squirrel	<i>Tamiasciurus hudsonicus</i>			X
Rock Squirrel	<i>Spermophilus variegatus</i>		X	
Golden-mantled Squirrel	<i>Spermophilus lateralis</i>		X	

Table 9 (Continued). Mammals known or likely to occur within the Browse Research Natural Area.

Common Name	Scientific Name	Occurs	Probably Occurs	May Occur
Least Chipmunk	<i>Eutamias minimus</i>		X	
Cliff Chipmunk	<i>Eutamias dorsalis</i>		X	
Porcupine	<i>Erethizon dorsatum</i>		X	
Mountain Cottontail	<i>Sylvilagus nuttallii</i>			X
Desert Cottontail	<i>Sylvilagus auduboni</i>			X
Mule Deer	<i>Odocoileus hemionus</i>	X		
Hoary Bat	<i>Lasiurus cinereus</i>	X		
Big Brown Bat	<i>Eptesicus fuscus</i>	X		
Little Brown Myotis	<i>Myotis lucifugus</i>			X
Long-legged Myotis	<i>Myotis volans</i>	X		
California Myotis	<i>Myotis californicus</i>			X
Long-eared Myotis	<i>Myotis evotis</i>			X
Yuma Myotis	<i>Myotis yumaensis</i>			X
Small-footed Myotis	<i>Myotis subulatus</i>			X
Cave Myotis	<i>Myotis velifer</i>			X
Fringed Myotis	<i>Myotis thysanodes</i>	X		
Western Pipistrel	<i>Pipistrellus hesperus</i>			X
Silver-haired Bat	<i>Lasionycteris noctivagans</i>	X		
Spotted Bat	<i>Euderma maculata</i>			X
Western Big-eared Bat	<i>Plecotus townsendi</i>			X
Mexican Big-eared Bat	<i>Plecotus phyllotis</i>			X
Pallid Bat	<i>Antrozous pallidus</i>			X
Big Freetail Bat	<i>Tadarida molossa</i>			X
Mexican Freetail Bat	<i>Tadarida brasiliensis</i>			X
Masked Shrew	<i>Sorex cinereus</i>			X
Dusky Shrew	<i>Sorex obscurus</i>			X
Vagrant Shrew	<i>Sorex vagrans</i>			X
Merriam's Shrew	<i>Sorex merriami</i>			X
Northern Water Shrew	<i>Sorex palustris</i>			X
Northern Pocket Gopher	<i>Thomomys talpoides</i>			X
Great Basin Pocket Mouse	<i>Perognathus parvus</i>			X
Longtail Pocket Mouse	<i>Perognathus formosus</i>			X
Canyon Mouse	<i>Peromyscus crinitus</i>			X
Deer Mouse	<i>Peromyscus maniculatus</i>		X	
Brush Mouse	<i>Peromyscus boylei</i>		X	
Pinyon Mouse	<i>Peromyscus truei</i>			X
Bushtail Woodrat	<i>Neotoma cinerea</i>		X	
Long-tail Vole	<i>Microtus longicaudus</i>			X

Table 10. Reptiles and amphibians known or likely to occur within the Browse Research Natural Area.

Common Name	Scientific Name	Occurs	Likely Occurs	May Occur
REPTILES				
Great Basin Fence Lizard	<i>Sceloporus occidentalis biseriatus</i>		X	
Northern Plateau Lizard	<i>Sceloporus undulatus elongatus</i>			X
Northern Sagebrush Lizard	<i>Sceloporus graciosus graciosus</i>			X
Tree Lizard	<i>Urosaurus ornatus</i>	X		
Side-blotched Lizard	<i>Uta stansburiana</i>			X
Short-horned Lizard	<i>Phrynosoma douglassii</i>	X		
Great Basin Western Skink	<i>Eumeces skiltonianus utahensis</i>	X		
Great Basin Western Whiptail	<i>Cnemidophorus tigris tigris</i>			X
Painted Desert Western Whiptail	<i>Cnemidophorus tigris septentrionalis</i>			X
Plateau Striped Whiptail	<i>Cnemidophorus velox</i>			X
Mojave Patch-nosed Snake	<i>Salvadora hexalepis mojavensis</i>			X
Regal Ringneck Snake	<i>Diadophis punctatus regalis</i>			X
Striped Whipsnake	<i>Masticophis lateralis</i>	X		
Red Coachwhip	<i>Masticophis flagellum piceus</i>			X
Great Basin Gopher Snake	<i>Pituophis melanoleucus deserticola</i>	X		
Utah Milk Snake	<i>Lampropeltis triangulum taylori</i>			X
California Common Kingsnake	<i>Lampropeltis getulus californiae</i>			X
Utah Sonora Mountain Kingsnake	<i>Lampropeltis pyromelana infralabialis</i>			X
Western Terrestrial Garter Snake	<i>Thamnophis elegans vagrans</i>	X		
Night Snake	<i>Hypsiglena torquata</i>			X
Great Basin Rattlesnake	<i>Crotalus viridis lutosus</i>	X		
Rocky Mountain Rubber Boa	<i>Charina bottae utahensis</i>			X
Western Yellow-bellied Racer	<i>Coluber constrictor mormon</i>			X
AMPHIBIANS				
(Arizona) Tiger Salamander	<i>Ambystoma tigrinum nebulosum</i>		X	
Great Basin Spadefoot	<i>Scaphiopus intermontanus</i>		X	
Southwestern Toad	<i>Bufo microscaphus microscaphus</i>			X
Red-spotted Toad	<i>Bufo punctatus</i>			X
Western Woodhouse Toad	<i>Bufo woodhousei woodhousei</i>			X
Canyon Treefrog	<i>Hyla arenicolor</i>			X
Northern Leopard Frog	<i>Rana pipiens</i>			X

According to Cook (1957), the Carmel Formation is overlain by the Entrada Sandstone of upper Jurassic age. In this vicinity the Entrada appears as a narrow outcrop (up to 150 feet/45 m thick) of extremely friable, red-chocolate and greenish-white sandstone. Grant (1995) does not recognize any distinct equivalent of the Entrada Formation as reported by Cook (1957), but may interpret this stratum to be the upper red siltstone/sandstone unit of the Carmel Formation. Within the BRNA, the Entrada Sandstone (if it is a separate unit) forms a band immediately west of and parallel to the Carmel Formation, on the west side of the drainage traversed by Trail #007.

Above the Carmel Formation/Entrada Sandstone is a thick sequence of unobtrusive, mostly dull-colored strata that are all of Cretaceous age. Cook (1957) and Grant (1995) differ in their interpretation of these strata.

Cook (1957) segregates these Cretaceous strata into five named formations, mapped as three separate units. The lowest of these, which overlies the Entrada unconformably, is a thin layer (0-80 feet/0-24 m) that correlates with the Dakota(?) Sandstone of the Colorado Plateau. The Dakota(?) is composed of gray, poorly-sorted conglomerate containing lenses of yellow-brown sandstone; beds of the latter are friable and form no projecting ledges. This unit grades upward into an 800-foot (245-m) section of alternating thin sandstones and shales (with some coal beds), identifiable as the Tropic Formation. The soft beds in the Tropic Formation are red, grape and chocolate silty marine shales and blue-gray to lavender siltstones; the ledge-formers are white to buff, fine-grained massive sandstones 1-5 feet (0.3-1.5 m) thick, which become yellower and show cross-bedding near the top of the formation.

The Dakota(?) and Tropic are mapped by Cook (1957) as one unit. This unit occurs in a broad belt through the center of the BRNA, including the ridge south from Coal Hill, the lower end of the valley west of this ridge (Mill Creek), and the lower nose of the ridge between Mill and Harmon Creeks. The eastern part of this belt, apparently representing the Dakota(?) sandstone and conglomerate, contains the best expressions of piñon-juniper woodlands in the BRNA. The remainder of this unit, apparently the Tropic Formation portion, is largely clothed with oak-mahogany-serviceberry and chaparral vegetation.

Gradationally overlying the Tropic Formation is an 1800-foot (550-m) thick sequence of strata that Cook (1957) correlates with the undivided Straight Cliffs and Wahweap Formations of the Colorado Plateau. This unit consists of sandy shale and lignite beds alternating with massive, resistant buff sandstones. Within the BRNA, the Straight Cliffs-Wahweap unit underlies all of the western side of the valley of Mill Creek, except for the extreme northwestern corner of the area. This unit largely supports oak-mahogany-serviceberry and, to a lesser extent, chaparral vegetation.

Lying disconformably above the Straight Cliffs-Wahweap unit is the uppermost Cretaceous stratum that Cook (1957) maps in the area of the BRNA, in its extreme northwestern corner. This is the Kaiparowits Formation, which generally consists of a basal conglomerate overlain by soft sandstones. The conglomerate is composed chiefly of rounded pebbles and cobbles of quartzite, quartz and chert. Above the conglomerate is a thin section of red, sandy shale. The bulk of the Kaiparowits Formation consists of friable, buff to white, cross-bedded sandstones in which iron concretions are numerous. The sandstones are weakly cemented and crumble readily, disintegrating into light-colored, gentle sandy slopes. By this erosional characteristic, the Kaiparowits Formation is easily distinguished from the more resistant, ledgy rocks of the underlying Straight Cliffs and Wahweap Sandstones.

Grant (1995) includes all of these Cretaceous strata (Dakota through Kaiparowits) in a single unit, the Iron Springs Formation. This is described as a sequence of alternating thin, buff to white, fine- to medium-grained sandstones and colorful shales that is up to 3800 feet (1160 m) thick. These rocks are possibly of fluvial, alluvial-plain and paludal origin. The variegated shales are purple, gray, red and yellow, though they are often poorly exposed on the vegetated slopes. The sandstones form repeating ledges, 10 to 40 feet (3-12 m) thick, visible on aerial photos at 50-foot (15-m) intervals. Grant (1995) does recognize that a 20-foot (6-m) thick basal unit of pebble to cobble, quartzose conglomerate may be the possible equivalent of the Dakota Formation.

Capping the Mesozoic sedimentary formations in several parts of the BRNA, chiefly on the broad ridge crest along the area's southern margin, is a mantle of Quaternary materials that Cook (1957) terms "high level gravels". These are deposits primarily derived from the monzonite porphyry core of the Pine Valley Mountains immediately to the west. These gravels are thought to have been deposited mainly by mudflows during the Pleistocene epoch. This inference is based in part on the presence of granitic

boulders, up to 20 feet in diameter, far from the base of the steep mountain slopes. These igneous gravel substrates support the best expressions of the evergreen chaparral vegetation within the BRNA, but are also occupied by oak-mahogany-serviceberry shrublands in some locations. This unit is not mentioned by Grant (1995), because it does not occur within that part of the BRNA covered by Grant's map.

Soils

The Soil Resource Inventory of the Dixie National Forest identifies eight soil map units within the boundary of the BRNA. Brief information about these units is presented below. More detailed descriptions and interpretations of the soils in these map units appear within the Soil Resource Inventory report, and are reproduced in Appendix G of this Record.

- Unit 43: Breece, moist - Bookcliff, deep families association, 3 to 15 percent slopes.
Deep soils on monzonite fans and benches with piñon-juniper, sagebrush and ponderosa pine.
65% Pachic Haplaborolls, coarse-loamy, mixed
20% Typic Argiborolls, fine-loamy, mixed
- Unit 44: Nehar family, 3 to 30 percent slopes.
Deep soils on monzonite fans with live oak and piñon-juniper.
75% Ustollic Haplargids, clayey-skeletal, mixed, mesic
- Unit 45: Rock outcrop - Sedgran family complex, 30 to 80 percent slopes.
Shallow soils on rocky sandstone hillslopes with piñon-juniper.
75% Rock outcrop
15% Lithic Ustic Torriorthents, sandy-skeletal, mixed, mesic
- Unit 47: Rock outcrop - Sedgran family complex, 10 to 30 percent slopes.
Shallow soils on sandstone hills and mesas with piñon-juniper.
45% Rock outcrop
45% Lithic Ustic Torriorthents, sandy-skeletal, mixed
- Unit 48: Rock outcrop - Chilton family complex, 30 to 70 percent slopes.
Deep soils on shale, limestone and gypsum hillslopes with piñon-juniper.
60% Rock outcrop
25% Ustic Torriorthents, loamy-skeletal, mixed (calcareous), mesic
- Unit 49: Chilton family, 5 to 30 percent slopes.
Deep soils on shale- and limestone-derived fans with piñon-juniper.
85% Ustic Torriorthents, loamy-skeletal, mixed (calcareous), mesic
- Unit 57: Rock outcrop - Canyon - Haplustalfs families complex, 30 to 50 percent slopes.
Shallow soils on sandstone and shale sideslopes with piñon-juniper.
35% Rock outcrop
30% Lithic Ustorthents, loamy, mixed (calcareous), mesic
20% Aridic Haplustalfs, loamy, mixed, mesic, shallow
- Unit 60: Pinitos - Pinitos, moderately deep families complex, 5 to 40 percent slopes.
Deep and moderately deep soils on sandstone and shale hillslopes with mountain brush.
55% Typic Haplustalfs, fine-loamy, mixed, mesic
30% Typic Haplustalfs, fine-loamy, mixed, mesic (moderately deep)

Lands

The Browse RNA is entirely reserved National Forest System land. Approximately 6% of the RNA (126 acres/51 ha) lies within the Pine Valley Mountain Wilderness. The remainder of the area has no encumbrances or withdrawals.

Cultural

No formal cultural resource inventory work has been done within the boundary of the BRNA. The potential for presence of prehistoric archaeological resources within the BRNA is moderate to high, based on findings from surrounding areas. Sites from the Anasazi culture have been found immediately north of the RNA. The area to the south of the RNA contains numerous Piute sites, and these people likely used the area of the BRNA for hunting, gathering and camping. The BRNA was not seen to contain any structures or cultural artifacts of more recent, post-European-settlement times.

Other

The Browse RNA contains no other known features of local (or wider) importance.

IMPACTS AND POSSIBLE CONFLICTS

Mineral Resources

Information on the presence and status of oil and gas leases in this region is maintained by the Bureau of Land Management (BLM). The oil and gas leasing plat for T39S R13W (dated 1/5/95) shows no oil and gas leases present within the boundary or in the near vicinity of the BRNA. No coal or geothermal leasing plats were seen to exist for this Township, so it is assumed that no leases of these types exist in or anywhere near the BRNA.

Information on mining claims for locatable minerals is also maintained by the BLM. Geographic index microfiche dated 8/18/98 show no claims, neither active nor inactive, in the part of T39S R13W occupied by the BRNA (i.e. Sections 19-21 and 28-33). In fact, the entire area of T39S R13W contains only two valid mining claims, both in Section 1, which is off the Dixie National Forest on BLM-administered land about 5 miles (8 km) northeast of the BRNA.

Based on its geologic setting and lack of interest in leases and claims, the area of the BRNA generally has a low potential for occurrences of commercially developable quantities of leasable or locatable mineral resources. The likelihood of impacts or possible conflicts from development of mineral resources appears to be very low or non-existent in the BRNA.

Grazing

The eastern front of the Pine Valley Mountains is currently closed to domestic livestock grazing. This closure has been in effect since about 1970, and was done primarily for watershed improvement reasons. Prior to this, the BRNA was within the Wet Sandy and Toquerville allotments. These allotments were grazed by various kinds of domestic livestock since the arrival of the first anglo settlers.

Livestock grazing will not be used as a management tool to maintain vegetation communities in the BRNA. The Forest has no plans at present to re-open the BRNA or the surrounding area to domestic livestock grazing. Therefore, establishment of the BRNA poses no conflicts with grazing management on this portion of the Pine Valley Ranger District.

Timber

The total forested area of the BRNA is about 230 acres (93 ha). None of these forested lands are included in the timber producing base of the Dixie National Forest, primarily because they are economically isolated. Therefore, designation of the BRNA will result in no values being withdrawn from the timber producing base.

Watershed Values

The BRNA contains two perennial streams, Harmon and Mill Creeks. These join within the area to form South Ash Creek, which flows out through the southeastern corner of the RNA. These streams support narrow bands of riparian habitat along their margins. The BRNA also contains a number of ephemeral or intermittent drainage courses, and possibly some unmapped springs or seep areas. In general, the BRNA provides good-quality water to downstream drainage basins.

Most of the BRNA is underlain by sedimentary rocks and igneous gravels that have relatively low natural erosion hazards, and thus are not significant sources of sediments to surrounding drainages. The east-central part of the BRNA contains exposures of the Carmel Formation (per Cook, 1957) which in general has a higher erosion hazard rating. However, these areas are generally not a major source of sediments because they are moderately well vegetated, their slopes are not uniformly very steep, and their overall areal extent is relatively small. Exposures of the Carmel Formation do have the potential to be an erosion problem if their surfaces are disturbed, which would not happen under RNA management. RNA designation should have no impact on the watershed properties of this area.

Recreation Values

The burgeoning population of southwestern Utah is placing increasing demands for recreational experiences and resources on the public lands of the region, including the Dixie National Forest. The Browse road (#037) is one of a small number of important public access points to the east side of the Pine Valley Mountains. This road leads to the Browse Guard Station, located just north of the BRNA; this site receives occasional use by public groups. Along the stretch of road that crosses through the BRNA are a number of undeveloped sites used for camping or picnicking, mainly in places where the road comes near to or crosses Mill and Harmon Creeks. Uses of this type seldom occur outside of the road-exclusion corridor, due to the prevalence of steep slopes and thick brush in the area. The Forest has no plans to put in developed campgrounds or other recreational facilities along the Browse road.

Segments of the two trails within the BRNA receive foot, horse, and probably low levels of motorized use. The general area of the BRNA also is popular for deer and cougar hunting. Other forms of recreational use that may occur include wildlife viewing, bird watching, enjoyment of scenic vistas, and general exploration of an interesting area.

Wildlife and Plant Values

Designation and management of the BRNA will maintain suitable habitat for special-status animals and plants that are known or likely to occur in the area.

Special Management Area Values

Management direction for the 126-acre (51 ha) portion of the BRNA that lies within the Pine Valley Mountain Wilderness will meet statutory mandates for the Wilderness (FSM 1920). Designation of the BRNA should have no affect on the management of the Wilderness or the purposes for which it was established.

Transportation Plans

The entire BRNA is subject to certain travel restrictions. The small part of the BRNA within the Pine Valley Mountains Wilderness is closed yearlong to all vehicles. The remainder of the BRNA is in a zone where motorized travel off roads and trails is prohibited except for snow machines operating on snow; this restriction exists for the purpose of erosion control.

The BRNA contains segments of two Forest trails. Trail #007 leads generally northward up an unnamed drainage from a point on the main road near the junction of Mill and Harmon Creeks, and exits the BRNA across its northeastern boundary. Trail #028 leads southwestward from the lowest switchback on the main road in the southwestern corner of the BRNA; only a very short segment of this trail lies within the BRNA. Because of their proximity to the Wilderness, these trails are considered as foot and horse trails. Use of this type is deemed to have no adverse impacts on the BRNA.

Forest Road #037 is excluded from the BRNA, effectively separating the RNA into two segments. The excluded corridor extends out 15 feet (5 m) from the edges of the road, or from the edges of vehicle pullouts or any previously-disturbed areas that currently exist along the road, including a 30-foot (10-m) extension around the gravel-pit disturbed area near the crossing of Harmon and Mill Creeks. Road #037 is closed to all motor vehicles except snowmobiles and ATVs at about the point where it enters the BRNA from November 15 to April 1, due to adverse weather and road conditions during this period.

The Forest intends to keep Road #037 open in order to maintain long-term access to the Browse Guard Station. No major widening or realignment efforts are planned for the road at this time. The objectives for use and maintenance of the road include keeping it drained (controlling water), avoiding erosion, and ensuring public safety. A gate on the road near the southeastern corner of the BRNA may be used to restrict access during conditions in which usage would damage the road.

MANAGEMENT PRESCRIPTION

In order to meet and maintain the objectives for which the BRNA is established (see the **OBJECTIVES** section of this Record), various management standards and prescriptions will apply to the area. General standards for RNA protection and management are contained in the Forest Service Manual, Section 4063.3. More specific management prescriptions for RNAs on the Dixie National Forest appear on pages IV-153 through IV-155 of the Forest Plan (USDA Forest Service 1986b); these pages are included in Appendix B of this Record. A synopsis of the management standards and prescriptions for the BRNA, drawn from these sources, is provided below.

Emphasis for use of the BRNA is on research, observations, monitoring, and educational activities that are nondestructive and nonmanipulative. Management of the BRNA will be directed toward maintenance of unmodified conditions and natural ecological processes. The future condition of the BRNA will be shaped by natural forces only (except for the presence of approved research markers and equipment), and human activities that directly or indirectly modify ecological processes will not be permitted within the area.

Use of the BRNA by scientists and educators is strongly encouraged. Special-use permits or cooperative agreements will be used to authorize and document scientific activity. Any public use that contributes to impairment of research or educational values will be discouraged or prohibited. Guidelines for scientific and educational use of the BRNA are contained in FSM 4063.33.

Logging activities, harvest of woodland products, fuelwood gathering, and direct habitat manipulation for wildlife are prohibited within the BRNA. The District and Forest should show the BRNA as a closed area on firewood cutting maps that are distributed to the public.

Livestock grazing will not be used as a management tool to maintain vegetation communities in the BRNA. Because the eastern front of the Pine Valley Mountains is closed to grazing by domestic livestock at present, there is no need to establish a level of acceptable casual or incidental livestock use that can be tolerated within the BRNA. Overnight pasturing of recreational pack stock is not permitted within the boundaries of the BRNA.

Construction of developed recreation sites, establishment of permanent camps, and use by Outfitter and Guide operations will not be permitted within the boundaries of the BRNA. Other recreational use of the BRNA (outside of the road exclusion corridor) is not expressly prohibited, but such use will not be encouraged so that the scientific and educational values of the area can be emphasized. The effects of recreational uses (if any) that occur within the boundaries of the BRNA will be evaluated periodically. Any such uses that are found to be threatening or interfering with the objectives for which the BRNA was established will be prohibited. Indicators of unacceptable degradation include the appearance of new social trails, creation of campsites, campfire rings, unnatural erosion patterns, and other indications of significant recreational use outside the road exclusion corridor.

Use of the two recognized National Forest trails within the boundaries of the BRNA (#007 and #028) is expected to continue, and such use is acceptable as long as it remains confined to the trails themselves. No roads, new trails, fences, signs, buildings or other physical improvements will be permitted within the boundaries of the BRNA, unless they contribute to the objectives or protection of the area.

Special closures may be used when necessary to protect the BRNA from actual or potential damage from public use, or to prohibit uses that are incompatible with the area's objectives, according to provisions of 36 CFR 261.50 (see also FSM 4063.3.6).

Fire hazard will not be reduced within the BRNA. Natural fires within the BRNA will be allowed to burn only within the parameters of an approved fire plan, and only under a prescription designed to accomplish the objectives of the area. Until such a plan has been approved by the Regional Forester in consultation with the Rocky Mountain Research Station Director, fires will be suppressed using means that will cause minimal damage to the BRNA. Use of heavy equipment in suppression efforts is strongly discouraged, and should be used only as a last resort. Use of chemical fire retardants in the BRNA likewise is strongly discouraged. Fire-caused debris will be left for natural decay, and post-fire rehabilitation is not recommended. If such rehabilitation must be done, as in cases of extreme flood or erosion hazards to people or property outside the BRNA, then only seeding with locally adapted ecotypes of indigenous species should be utilized.

No actions will be taken against endemic insects, diseases, wild plants or animals in the BRNA, unless the Regional Forester and Station Director deem such actions necessary to protect the features for which the BRNA was established or to protect adjacent resources.

Introduction of exotic plant or animal species into the BRNA is prohibited, and precautions will be taken to avoid such introductions. Insofar as is practical, measures will be taken to control or eradicate existing or new occurrences of exotic plant or animal species from the BRNA, particularly those that readily invade native communities and/or alter natural ecological conditions. If re-seeding is needed following a fire (as mentioned above), then the seed mix will not contain non-native plant species. If pack stock are determined to be a vector for introduction of non-native plant species, then weed-free feed requirements will be implemented.

Where pest management or noxious weed control activities are necessary within the BRNA, they will be as specific as possible against target organisms, and will induce minimal impacts to natural values and other components of the ecosystem.

Withdrawal of the BRNA from mineral entry is not deemed to be necessary as of the date of its establishment. In the event that such action becomes necessary, procedures for doing so are listed in FSM 4063.35.

Mineral lease applications, permits and licenses within the BRNA will be reviewed and processed in a timely fashion, recommending to the Bureau of Land Management such measures and stipulations as necessary to protect surface resources. New leases within the BRNA will include the stipulation for No Surface Occupancy.

Management direction for the 126-acre (51 ha) portion of the BRNA that lies within the Pine Valley Mountain Wilderness must meet statutory mandates for the Wilderness (FSM 1920).

Vegetation Management

As mentioned above in the **MANAGEMENT PRESCRIPTION** section, domestic livestock grazing will not be used as a management tool to maintain vegetation communities in the BRNA.

Fire plays an important functional role in the upland shrub-dominated communities represented in the BRNA, especially in the evergreen chaparral type. Over time, fire suppression alters the "natural" or pre-settlement fire regime in these communities, and leads to changes in their structure and function. In the long term, continued fire suppression may even convert these communities into types whose response to fire is entirely unpredictable.

Therefore, inventory, monitoring and research should emphasize the role of fire as a natural process governing these upland shrub communities, and evaluate the risk of continued wholesale fire suppression. Such knowledge should be incorporated into an approved fire plan for that portion of the Forest in which the BRNA lies, and allow for conditions under which certain naturally-ignited fires may be allowed to burn within the BRNA. Such a plan will identify those parts of the BRNA that are allocated for prescribed non-suppression of naturally ignited fires, and those parts that are reserved for permanent suppression of fire (per FSM 4063.41.5.j(1)).

Monitoring

To ensure that only authorized use is occurring and to determine if any threats may be imminent, the BRNA should be visited annually or biennially by Forest Service personnel or a cooperative partner. A stewardship monitoring module prepared by the Natural Areas Program Office in Missoula MT is available for use in documenting the results of such general monitoring visits.

Establishment of permanent monitoring plots is encouraged within the BRNA. These would provide information required to manage effectively and protect the area over time. Long-term ecological monitoring in RNAs will make significant contributions to understanding of how ecosystem patterns and processes change over time.

ADMINISTRATION RECORDS AND PROTECTION

Administration, records and protection of the BRNA are the ultimate responsibility of the Director of the Rocky Mountain Research Station. The Station Director, in consultation with the Forest Supervisor, Dixie National Forest, and District Ranger, Pine Valley Ranger District, will approve all management plans and oversee and coordinate approved research. The Forest Supervisor will execute approved management plans for the BRNA and administer, manage and protect the area. The District Ranger has responsibility for direct administration, protection and management of the BRNA in accordance with this

Establishment Record, Forest Plan management direction, and any subsequent management plans for the BRNA.

Requests to conduct research within the BRNA are referred to the Station Director, who will be responsible for any studies or research conducted. The Station Director will evaluate research proposals, and will coordinate the activity with the District Ranger prior to the initiation of any project. All plant and animal specimens collected in the course of research conducted in the BRNA will be deposited with the Monte L. Bean Life Science Museum and Herbarium at Brigham Young University, and/or with federal agency herbaria and museums approved by the Station Director.

Records for the BRNA will be maintained in the following offices:

Intermountain Region, Ogden, UT
Dixie National Forest, Cedar City, UT
Pine Valley Ranger District, St. George, UT
Rocky Mountain Research Station, Ogden, UT

ARCHIVING

The Research Natural Area Coordinator at the Intermountain Regional Office, Ogden, UT, will be responsible for maintaining the BRNA research data files, including studies conducted in the BRNA, lists of plant and animal species and plant communities occurring within the BRNA, and lists of herbarium and museum specimens collected. Descriptive data from the BRNA will also be stored in the computerized natural areas database maintained by the Utah Natural Heritage Program in Salt Lake City, UT.

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